

(12) UK Patent Application (19) GB (11) 2 370 326 (13) A

(43) Date of A Publication 26.06.2002

(21) Application No 0128437.1

(22) Date of Filing 28.11.2001

(30) Priority Data

(31) 09742756 (32) 20.12.2000 (33) US

(71) Applicant(s)

Caterpillar Inc
(Incorporated in USA - Delaware)
100 NE Adams Street, Peoria, Illinois 61629-6490,
United States of America

(72) Inventor(s)

Jeffrey L Degroot
Hans P Dietz
Susan J Gaugush
Thomas G Skinner

(74) Agent and/or Address for Service

Murgitroyd & Company
Scotland House, 165-169 Scotland Street,
GLASGOW, G5 8PL, United Kingdom

(51) INT CL⁷

F16H 61/16 61/02

(52) UK CL (Edition T)

F2D DCC DC51 DC52 D100 D101 D130 D132 D151 D189
D218 D250 D251

(56) Documents Cited

US 5819585 A **US 5545108 A**
US 5416698 A **US 4463842 A**
US 3927579 A

(58) Field of Search

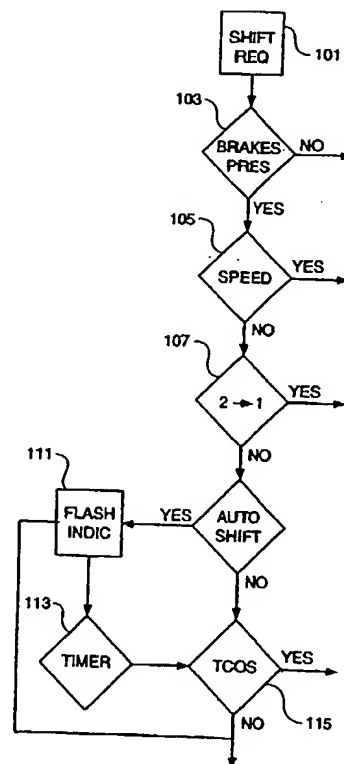
UK CL (Edition T) **F2D DCC**
INT CL⁷ **F16H 61/02 61/16**
ONLINE: WPI; EPDOC; JAPIO.

(54) Abstract Title

Preventing overspeeding of an engine by inhibiting improper gear selection

(57) A method of preventing overspeeding of an engine and attached ancillary devices in a vehicle, eg track loader, includes inhibiting a gear change via an electronic control module. The gear change is inhibited if 1) a brake accumulator pressure is above a preselected value, 2) the vehicle ground speed is above a certain value, 3) an improper gear change is attempted and 4) a torque converter output speed is above a preselected value. In another embodiment the torque converter lock-up solenoid activated in response to torque converter output speed which is compared to selected values to engage or disengage a lock-up clutch. In a further embodiment engine over speeding is prevented by engine braking using a compression release braking system (CRBS), which responds to engine RPM, and may be used in a manual or automatic mode. A destroked variable displacement pump having an adjustable swashplate may be controlled in response to engine RPM, thereby preventing engine overspeeding.

Fig - 2 -



GB 2 370 326 A

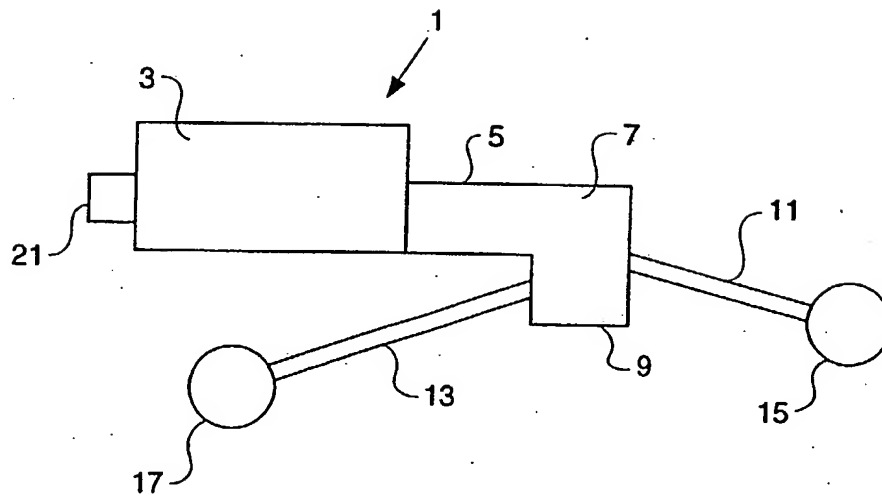
Fig. 1.

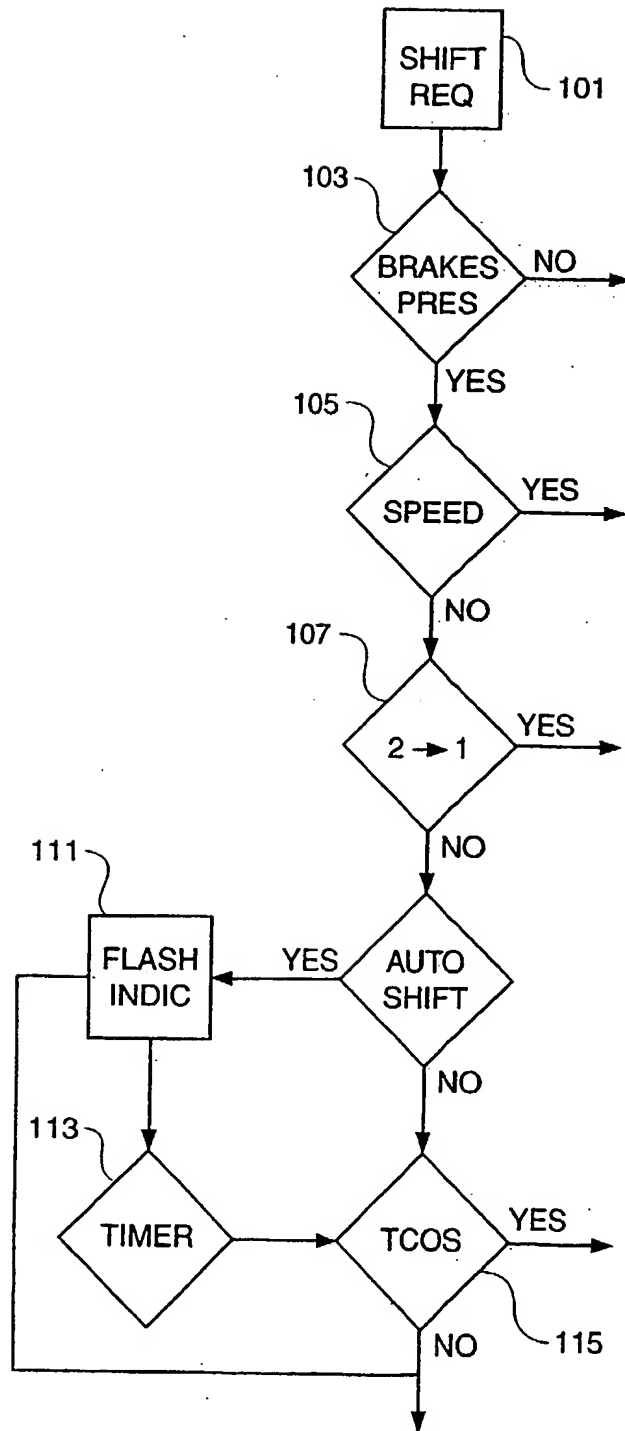
FIG. 2.

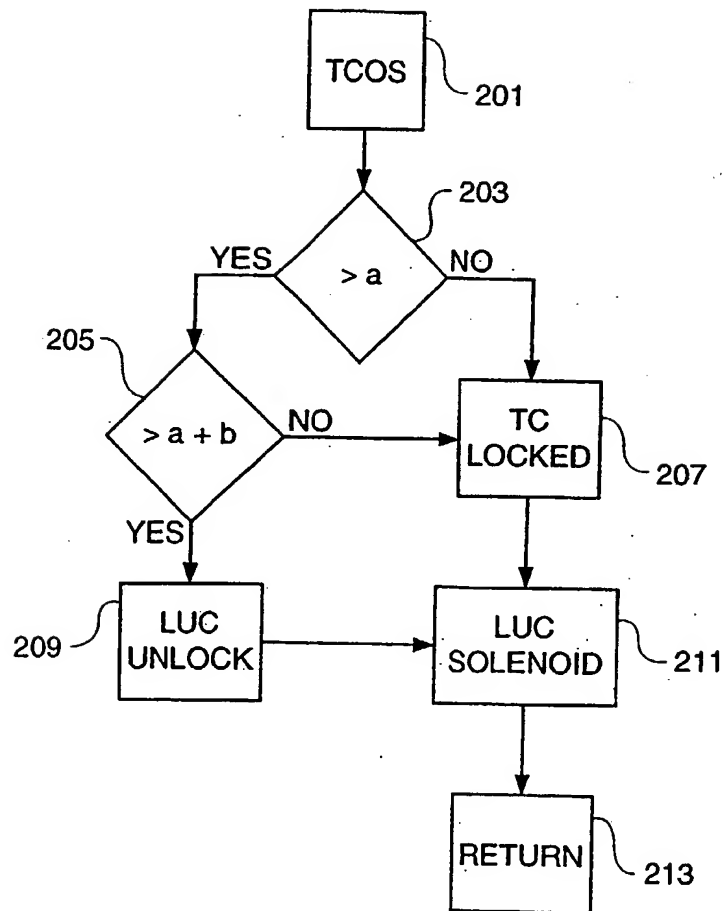
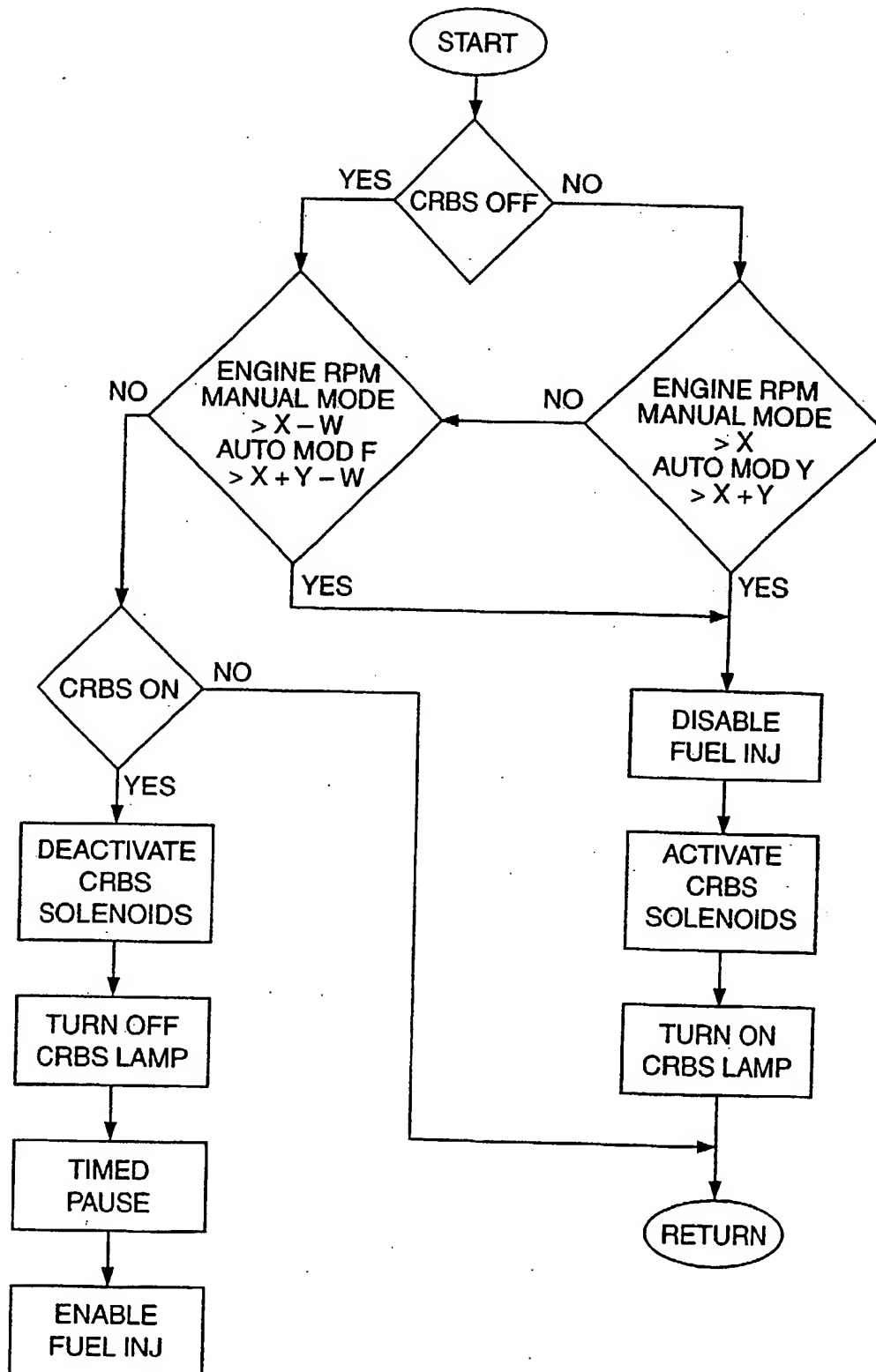
FIG. 3

FIG - 4 -

DescriptionOVERSPEED PREVENTION5 Technical Field

This invention relates generally to control methods to prevent engine, transmission and ancillary device overspeed in vehicles having an internal combustion engine mechanically connected to the wheels
10 or tracks of the vehicle and more particularly to sequences of steps initiated automatically by electronic control modules to prohibit damage due to operator error or component failure.

15 Background Art

Modern heavy duty trucks and heavy duty off-road mining and construction equipment have engines and drivetrains which are susceptible to extensive and expensive damage when operated in excess of about 2500
20 to 3000 RPM (crankshaft revolutions per minute), depending upon design. High-pressure hydraulic pumps, especially variable output pumps, are similarly speed limited. The advent of electronic engine controls allows engine RPM to be controlled by interrupting
25 ignition pulses in Otto cycle engine and by limiting fuel flow in Diesel cycle engines. Neither approach prevents overspeed when a vehicle is in a gear and the weight of the load creates momentum sufficient to backload through the transmission and force the engine
30 speed above the critical limit.

U.S. Patent No. 5,587,905 to Yesel et al., granted 24 December 1996, discloses a system for preventing overspeed in heavy equipment having an electronically controlled transmission and engine by
5 disallowing downshifting the transmission to the desired gear as engine and transmission speeds allow. A microprocessor-based electronic module serves as a controller which compares various input signals to stored benchmarks and responds in a predetermined
10 pattern.

U.S. Patent No. 5,416,698 to Hutchison, granted 16 May 1995, is directed to a warning system to advise a vehicle operator that a gear has been selected which will cause overspeeding or
15 underspeeding of the engine when the clutch is re-engaged.

U.S. Patent No. 4,463,842 to Redzinski, granted 07 August 1984, discloses an automatic lockup of a torque converter in the driveline of a work
20 vehicle responsive to the speed of the output shaft of a torque converter.

U.S. Patent No. 5,615,653 to Faletti et al., granted 01 April 1997, is representative of compression release engine braking technology
25 frequently employed on Diesel engines for freight hauling.

The prior art addresses individual aspects for avoiding gear selection errors and smoothing techniques for cruise control systems. None of the
30 prior art is directed to unified systems to protect

engines, pumps and ancillaries from overspeed when a combination of weight, slope and mechanical coupling of engine and drivetrain produce a potentially damaging overspeed through backloading.

5 The present invention is directed to overcoming one or more of the problems or disadvantages associated with the prior art.

Disclosure of the Invention

10 The invention is directed to systems for the protection of components of a heavy vehicle from damage due to overspeed of the engine and engine driven components.

15 In a first aspect of the invention, a system is provided to override the operator's manual control of the gear selection in a transmission having electronic shifting control. In a second aspect of the invention, there is provided a system to disengage a lockup clutch of a torque converter when a potential
20 overspeed condition is identified in an output from the transmission.

 In another aspect of the invention, there is provided a system to slow and optionally retard an engine approaching an overspeed condition by
25 overriding an operator-selected engine speed control and by optionally phasing in a compression release engine braking system.

 In a further aspect of the invention, a system is provided to destroke variable capacity
30 hydraulic pumps associated with the engine in response

to the same signals provoking a system for the
override of the operator-selected engine speed.

In yet another aspect of the invention, the
control functions for transmission control, torque
5 converter control, engine control and pump destroking
are controlled by a microprocessor which also
transmits visual/or and auditory messages to the
operator, records operating events and allows operator
override in the event of the failure of other systems
10 on the vehicle.

Brief Description of the Drawings

Fig. 1 shows the location of basic
components of an off-road work vehicle according to an
15 embodiment of the present invention.

Fig. 2 is a schematic of a transmission
control system according to an embodiment of the
present invention.

Fig. 3 is a flow chart of a lockup clutch
20 system control according to an embodiment of the
present invention.

Fig. 4 is a flow chart of an engine control
system according to an embodiment of the present
invention.

25

Best Mode for Carrying Out the Invention

The invention is applicable to any vehicle
having a mechanical connection between an engine and
driven wheels or tracks. In the preferred embodiment,
30 the engine is a Diesel engine and the transmission is

a planetary transmission connected to the engine through a torque converter having a lock-up clutch. Exemplary vehicles for the application of this invention are track loaders, wheel loaders, integrated
5 tool carriers, wheel dozers, backhoe loaders, excavators, trucks, tractor-scrappers and any other configuration of a vehicle capable of carrying a load. The invention is particularly adapted to vehicles having hydraulic implement controls and other power
10 take-off devices which are RPM restricted.

Diesel engines for heavy truck and off-road implement applications are high torque, usually turbocharged direct injection motors which are operated within a narrow RPM range. For construction
15 and other off-road use, it is preferred to operate at a preset RPM corresponding to maximum fuel economy. The speed is set using a "throttle", the position of which is read by sensors in the cab. The speed is regulated by electronically controlling the fuel flow
20 rate.

A compression release engine braking system (CRBS) is a method for maximimzing the engine retardation by converting the engine into an air compressor. Numerous systems are available and all
25 are based on fuel shut-off followed by overriding the exhaust valves to cause exhaust valves to open as a piston approaches top dead center on the compression stroke. The manner of actuation is not critical to this invention although a variable system as disclosed
30 in U.S. Patent No. 5,615,653 may be preferred to the

more conventional systems which are "all or nothing" in operation. Conventional engagement of the CRBS is by a manual switch. In accordance with this invention, the CRBS also may be automatically
5 triggered or phased in response to a sensed crankshaft rotation speed. Likewise, the CRBS is deactivated either manually or in response to a lower RPM set point. Upon deactivation of the CRBS, the engine speed is resumed at a pre-set value such as low idle
10 or the control is resumed by the operator.

The transmission may be of any type including straight cut, bevel cut, counter shaft or lay shaft and planetary transmissions and either clutch coupled using sliding clutch collars or crash.
15 In consideration of the torque throughout requirements and the need for smooth gear change transitions, an electronically controlled planetary transmissions with perimeter-mounted clutch packs is preferred.

Fig. 1 shows the arrangement of components
20 in a typical configuration for a wheel loader. The drivetrain 1 consists of an engine 3, a clutch 5 in the form of a torque converter connecting the drive from the engine 3 to transmission 7. The output from transmission 7 is through a power take off 9 from
25 which propeller shafts 11, 13 transmit power to axles 15, 17. The configuration of power take off 9, propeller shafts 11, 13 and axles 15, 17 may vary with the application and are not critical to the invention. One or more pumps 21 are driven from engine 3 to
30 provide the hydraulic pressure for operation of

various system such as steering, lifting, braking, fan drives, etc.

The engine 3 may be a two or four stroke Diesel engine. The number of cylinders and
5 displacement are not critical except as they impose limitations on maximum safe operational RPM. Commercial diesel engines are normally turbocharged, directly injected, and have a pushrod-driven valve train, the latter typically being the determining
10 factor in qualifying the upper limit of engine operating speed. For purposes of this description, the term "overspeed" will be used to describe an engine operating condition at which damage to the engine is likely to occur. What constitutes engine
15 overspeed depends upon the particular engine specification, but for engines of this type is usually between 2500 and 3000 RPM. "Overspeed" also applies to pumps and any other ancillaries caused by high engine RPM. Overspeed of engine driven ancillaries
20 may be different from that of the engine.

The torque converter 5 preferably is an impeller clutch type characterized by having an electronically activated lockup to eliminate slippage above a specified RPM or when other throughput values
25 have been achieved. Lockup clutches successfully overcome the inherent inefficiency of a torque converter by eliminating slippage between engine and driven axles so that the drivetrain functions analogously to one with a conventional friction
30 clutch. In doing so, it also allows the axle to

rotate the engine without slippage when the transmission is in gear and when the axles are being rotated by tires or tracks. Such "back propagation" or backloading" may cause overspeeding of the engine
5 is certain circumstances.

The power take-off 9 and downstream drive train units such as propeller shafts 11, 13 and axles 15, 17 are not critical to this invention except that they are conventional and do not include free-wheel
10 ratchets, viscous couplings or other energy transfer limiting devices.

Downshifts by the operator may be intentional or inadvertent (picked wrong gear). In either eventuality, when the gear change is completed,
15 the vehicle speed may cause the engine to overspeed. To prevent such an occurrence, a logic sequence as shown in Fig. 2 is programmed into the shift control circuitry of an electronic shift control module to avoid inappropriate gear changes.

20 When a shift request 101 is made for a lower gear, the request is temporarily disallowed until a series of checks can be made. Firstly, the hydraulic pressure 103 in the brake system is interrogated. If the pressure is below a preselected value, a real or
25 potential runaway condition exists and the downshift request is honored. If brake pressure is adequate, then groundspeed 105 is interrogated. If the groundspeed is greater than a preselected value, usually 2 - 3 kph, the request is temporarily
30 disallowed and the request passed to another decision

point. If the groundspeed is below the preselected value, the vehicle itself is functionally stopped and any gear selection is allowed. Otherwise, the request is denied and passed to the next decision point.

5 If the vehicle is not stopped, the specific change requested is interrogated at 107. Specific requests may be allowed. For example, a change to the lowest (highest numerical) gear from the next lowest gear normally would be allowed. Other requests would
10 be temporarily disallowed.

 The final discriminator is the torque converter output speed (TCOS). In normal mode, the TCOS is a good approximation of engine RPM. In a lockup mode, it is the engine RPM. When a shift
15 request has been made, the electronic control module 115 can compare the actual TCOS with the TCOS in the requested gear. The comparison may be made using lock-up tables or simple algorithms. When the TCOS in the requested gear would exceed a predetermined value,
20 the shift request is denied.

 Autoshift™ is a proprietary Caterpillar™ system which controls the gear range selected by the transmission band on the TCOS. When Autoshift™ is activated, an additional loop is inserted between the
25 gear change analysis at 107 and the RPM comparison at module 115. If the downshift at 107 has been denied and Autoshift 109 is engaged, a flashing gear indicator is displayed in the cab advising the operator that a change has been requested. Then the
30 TCOS analysis 115 is performed.

The scenario described above will prevent damage to the engine and engine driven components as a result of overspeed when the cause is improper gear selection by the operator or misadjustment of the gear selection control system. Gear selection control cannot protect against the overspeed when the gear was properly selected but the vehicle is in a "runaway" situation such as descending a grade. To protect against such "back propagating" of speed of the engine, it is necessary, as a first step, to perform a soft decoupling of drivetrain from engine.

As shown in Fig. 3, decoupling takes place when torque converter speed is sensed to exceed a preselected value using the criteria described above for denial of a request for a downshift. A torque converter RPM sender 201 sends a signal to a comparator 203. If the signal indicates a torque converter speed below the preset value (a), a signal is sent to a relay 207 through which a signal is sent to the lockup clutch solenoid 211 to take no action (null signal). When the torque converter speed exceeds a preselected value (a), a signal is sent to a second preselected value (a + b). If the value is less than the second preselected value, a signal is sent through relay 207 to the lockup clutch solenoid 211 to take no action (null signal). If the value is greater than the second preselected value, a signal is sent to relay 209 to unlock the clutch. In turn, a signal is sent to the lockup clutch solenoid 211 to

disengage the lockup. The cycle is then repeated at return 213.

The slippage through the torque converter is sufficient to prevent overspeed of a transient nature. When the first and/or second preselected value is reached, a suitable combination of warning signals to the operator would be expected to induce the operator to upshift, brake or take other appropriate compensatory action. When the situation becomes a true runaway, additional responses may be required. Since the occurrence of a true runaway would likely entail a major mechanical failure or the incapacitation of the operator, it is desired that the response should be fully automatic.

The engine control system of choice is a compression release braking system (CRBS), commonly referred to as a "Jake Brake" after its primary supplier, Jacobs Vehicle Systems IncTM. The operation of the engine control incorporating a CRBS is illustrated in Fig. 4.

A clock 301 times the electronic module which controls the engagement of the CRBS. At regular intervals such as every 60 msec, the routine is commenced. The first step is to interrogate whether the CRBS is on or off 303. If the CRBS is on, an interrogation is made of engine RPM 305. If the engine RPM is greater than a preselected RPM, the remaining CRBS sequence is triggered. If the engine RPM is less than a preselected RPM, a signal is sent to a second comparator 307.

In the preferred embodiment, the CRBS may be used in manual or automatic mode. In manual mode, preselected RPM's would normally be lower because the operator had planned on using CRBS along the transportation route. In automatic mode, the CRBS is acting as a failsafe and the engine rate would be higher. This is indicated in Figure 4 by lower RPM X and higher RPM X + Y.

The second comparater 307 looks at the RPM signal and determines whether the engine RPM is greater than a second preset value which is lower than the first preset value interrogated at 305. It is at this state where a decision is made to change the step of the CRBS. If the engine RPM exceeds the second preset value, a signal is sent to disable (or continue to disable) the fuel injection 309. The CRBS solenoids 311 are then activated (or remain activated), the CRBS lamp 313 is activated (or remain activated) and the cycle returns to 315 to start.

If the engine RPM as determined at 305 is higher than the preselected values, then the cascade of fuel injection, solenoid and lamps described above is followed.

If the engine RPM as compared at 307 is less than the second preselected values, the on or off status of the CRBS is again interrogated at 317. Of the CRBS had been off and remains off, the system returns 315. If the CRBS is on, the sequence begins to disable the CRBS and being normal operation. Firstly, the CRBS solenoids are deactivated 319

followed by turn off of the CRBS lamps. While the volumetric pattern in intake and exhaust is returned to normal, there is a pause 323 for several tenths of a second. At the end of the pause, the fuel injection
5 is enabled 325 and normal engine operation resumes.

Engagement of the CRBS may be done manually using lower set point values for the preselected comparison values.

As an additional safety factor, a "dead man
10 switch" or button nay is used, and, CRBS may be automatically engaged in response to that control system.

The systems disclosed have been described as functioning independently of each other to prevent
15 overspeed. As a result, downshift inhibition and/or lockup clutch disengagement may be applied as a separate or unified system to the drivetrain independent of any motor control functions and by sensing only clutch and transmission component
20 operating values. Engine CRBS operates on the engine regardless of clutch and transmission controls.

An integrated system applying all three systems is contemplated and may be integrated through a single computer system. As an additional advantage
25 of such integration, a warning system of lights and buzzers may be standardized inside the cab to provide advance warning to the operator. The events may be logged by the computer in histogram bins correlated to the values reported. Such logging may be valuable in

compiling a service record and estimating time to the next major service.

An additional protection may be used to protect variable displacement hydraulic pumps, especially swash-plate type pumps. Pumps of this type are RPM sensitive and the main shaft typically driven either directly from the engine or at some function of the engine speed (i.e., an engine RPM value). The angle of the swash plate typically is controlled by a solenoid. The RPM and current are exemplary and are selected, in practice, on the pump and engine actually used. Alternative methods which are a function of engine RPM are also contemplated, depending upon the method of activation of the swash plate control.

15

Industrial Applicability

The torque converter RPM sender 101 provides a continuous signal indicating output speed. When an down-shift request is made, the control module interrogates the RPM sender 101, the brake accumulator pressure signal 111, the ground speed sensor 109 and the gearchange requested. Low brake pressure is the override or default condition and allows downshift to proceed. If brake pressure is sufficient, ground speed is interrogated to determine if it is less than a predetermined threshold. If yes, the shift is allowed. The threshold is set at a low speed, essentially equal to stopped and the selection allows a downshift to any gear from a stop. If brake pressure is sufficient and speed is in excess of the

threshold, the selected gear is queried. If the selected gear is the lowest gear, the shift is allowed; if not, the shift is denied subject to a query of the torque converter output speed. If the
5 speed is above a preselected rate, the shift request is denied. If less than the preselected rate, the shift request is acknowledged.

The sequence of events described above protects against overspeed damage due to improper gear
10 selection while making allowance for low speed maneuvering and for emergency speed retardation in the event of loss of brake pressure.

When the torque converter output speed exceeds a preselected value in a gear, the electronics
15 control unit (ECU) 203 interrogates whether the torque converter lockup clutch is in operation. If yes, the control unit makes a second inquiry to determine if the output speed exceeds a second, higher value. If yes, the torque converter lockup clutch is disengaged
20 and direct mechanical connection through the transmission ceases. If the second threshold is not met, no response occurs. When the speeds decrement to below the preselected first and second thresholds, the lockup is re-engaged according to the standard
25 protocol for lockup engagement. The disengagement of the lockup clutch provides a cushion against overspeed through backloading and allows the operator to take other action to avoid damage to the engine and ancillaries.

The engagement of the CRBS as a function of engine RPM serves to prevent engine overspeed from any cause but especially in "runaway" situations. After determining if the CRBS is off or on, the engine RPM
5 is interrogated at decision block 305 or 307 of the engine control unit to determine whether the RPM is above or below a preselected threshold, which may vary depending upon whether the CRBS is in manual or automatic mode. If the preselected RPM has been
10 exceeded, an initiation procedure is commenced to shut off fuel at 309 and activate the CRBS solenoids 311 the activation is indicated by a lamp 313 in the cabin. If the RPM is below the preselected RPM, the CRBS is disengaged if on, otherwise the ECU returns to
15 the beginning of its cycle. Severe damage to the structure of the vehicle and the internal mechanical components is avoided in this manner.

The engine RPM output value may be used to ramp down or destroke variable rate hydraulic pumps by
20 increasing the total solenoid current as a function of engine speed, either by a lookup table or a mathematical model calculation.

Other aspects, objects and advantages of this invention can be obtained from a study of the
25 drawings, the disclosure and the appended claims.

Claims

1. A method to prevent overspeed of an internal combustion engine and engine-driven ancillary components in a vehicle having an engine connected through a clutch and transmission to ground contacting wheels or tracks when overspeed is caused by improper selection of gears through an electronic shift control module when operating in a present gear, said method comprising:
 - determining the torque converter output speed;
 - determining the pressure in the brake accumulator;
 - determining the ground speed of the vehicle;
 - interrogating the shift control module to determine the present gear;
 - interrogating the shift control module to determine if a gear selection request has been made;
 - responding to a gear selection request by performing the steps of:
 - allowing the request if the brake accumulator pressure is above a preselected value;
 - denying the request if the brake accumulator pressure is above a preselected value;
 - responding to a denied request by interrogating the ground speed determination and allowing the request if the ground speed is below a preselected value or denying the request if the ground speed is above a preselected level;

responding to a denial of a request by
interrogating the shift control module to determine
whether the request is for a shift from a second
lowest gear to a lowest gear;

5 allowing a shift request from a second
lowest gear to a lowest gear; or

 denying a request for a change other
than from a second lowest gear to a lowest gear;

 responding to a denied request in by
10 interrogating the torque converter output speed; and
 allowing the request if the torque
output speed is less than a preselected value;

 or

 denying the request if the torque
15 output speed is greater than a preselected value; and
 repeating the method.

2. A method according to claim 1 further
comprising activating a sensory signal after a shift
20 has been denied and maintaining said activation for a
preselected time before initiating any other action.

3. A method according to claim 1 or claim
2 wherein the preselected torque output speed has one
25 value for all requests.

4. A method according to claim 1 or claim
2 wherein the preselected torque output speed is
different for each request and stored in a lookup
30 table.

5. A method according to any one of the

preceding claims wherein the preselected ground speed is determined at a transmission output shaft.

5 6. A method according to any one of the preceding claims wherein the preselected ground speed is determined at at least one ground contact wheel or track.

10 7. A method according to any one of the preceding claims wherein the preselected ground speed is less than 3 kilometers per hour.

15 8. A method to prevent overspeed of an internal combustion engine and engine driven ancillary components in a vehicle having an engine connected through a torque converter clutch having a lockup and a transmission to ground contacting wheels or tracks when overspeed is caused by backloading from the wheels or tracks to the engine, comprising
20 the steps of:

 determining whether the torque converter is locked up;

 determining whether the torque converter output speed is less than or greater than a
25 preselected value;

 taking no action if the torque converter output speed is below a preselected value and the torque converter is locked up;

 activating the torque converter lock-up
30 solenoid to engage lock-up if the torque converter

output speed is below a preselected value and the torque converter is not locked up;

taking no action if the torque converter speed is greater than a preselected value and the

5 torque converter is not locked up;

deactivating the torque converter lock-up solenoid if the torque converter output speed is greater than a preselected value and the torque converter is locked up; and

10 repeating the method.

9. A method according to claim 8 further comprising activating a sensory signal within a cab of the vehicle in response to a determination that
15 the torque converter output speed is greater than a preselected value.

10. A method according to claim 8 or claim 9 wherein the preselected value of the torque
20 converter output speed for disengaging and engaging the torque converter lock-up is the same.

11. A method according to claim 8 or claim 9 wherein the preselected value of the torque
25 converter output speeds for disengaging and engaging the torque converter lockup are different.

12. A method to prevent overspeed of an internal combustion engine and engine-driven
30 ancillary component in a vehicle having an engine equipped with an compression release braking system

(CRBS) connected through a clutch and transmission to ground contacting wheels or tracks when overspeed is caused by backloading from the wheels or tracks to the engine, comprising the steps of:

- 5 determining whether the CRBS is activated
 or
deactivated;
- determining whether the CRBS is in manual
or automatic mode;
- 10 determining the RPM value of the motor;
 comparing the engine RPM value to one or
more preselected values;
- sending a signal to engage a CRBS system if
the engine RPM value exceeds one or more preselected
15 values; or
- sending a signal to disengage a CRBS system
if the engine RPM value is less than one or more
preselected values; and
- 20 13. A method according to claim 12 wherein
the engine RPM value required disengaging the CRBS is
less than the engine RPM value required to engage the
CRBS.
- 25 14. A method according to claim 12 or
claim 13 wherein the CRBS includes a sensible signal
in a cab to indicate activation.
- 30 15. A method according to any one of
claims 12 to 14 wherein the preselected values are
different for manual and automatic activation mode.

16. A method according to any one of claims 12 to 15 further comprising a dead man switch to signal engagement of the CRBS.

5 17. A method according to any one of claims 12 to 16 further comprising destroking one or more variable rate hydraulic pumps in response to the RPM value of the motor.

10 18. A method according to claim 17 wherein said destroking is performed by adjusting an electronic signal to the means for controlling the swash plate angle.

15 19. A system to prevent overspeed of an internal combustion engine and engine-driven ancillary components in a vehicle having an engine equipped with a compression release braking system (CRBS) connected through a torque converter clutch
20 having a lock-up and a transmission to a ground contacting wheels or tracks comprising:

 means for preventing incorrect gear selection comprising denying a downshift request until criteria of brake pressure, ground speed, the
25 nature of the requested downshift and the torque converter clutch output speed have been determined;

 means for disengaging a lock-up clutch when the speed of the torque converter exceeds a preselected value;

means for automatically engaging at
compression release braking system when an engine RPM
value exceeds a preselected value; and

means for destroking a variable
5 displacement hydraulic pump based upon the engine RPM
value.

20. A method for preventing overspeed of
an internal combustion engine and engine-driven
10 ancillary components in a vehicle having an engine
connected through a clutch and transmission to ground
contacting wheels or tracks when overspeed is caused
by improper selection of gears through an electronic
shift control module when operating in a present
15 gear, substantially as described hereinbefore with
reference to the accompanying drawings.

21. A method for preventing overspeed of
an internal combustion engine and engine driven
20 ancillary components in a vehicle having an engine
connected through a torque converter clutch having a
lockup and a transmission to ground contacting wheels
or tracks when overspeed is caused by backloading
from the wheels or tracks to the engine,
25 substantially as described hereinbefore with
reference to the accompanying drawings.

22. A method for preventing overspeed of an internal
combustion engine and engine-driven ancillary
30 component in a vehicle having an engine equipped with
a compression release breaking system (CRBS)

connected through a clutch and transmission to ground
contacting wheels or tracks when overspeed is caused
by backloading from the wheels or tracks to the
engine, substantially as described hereinbefore with
5 reference to the accompanying drawings.

23. A system for preventing overspeed of
an internal combustion engine and engine-driven
ancillary components in a vehicle having an engine
10 equipped with a compression release breaking system
(CRBS) connected through a torque converter clutch
having a lock-up and a transmission to a ground
contacting wheels or tracks, substantially as
described hereinbefore with reference to the
15 accompanying drawings.



Application No: GB 0128437.1
Claims searched: 1 to 7 and 20

Examiner: Mike Mckinney
Date of search: 15 February 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): F2D (DCC)

Int Cl (Ed.7): F16H 61/02, 61/16.

Other: ONLINE: WPI; EPODOC; JAPIO.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 5819585 (DARNELL)	
A	US 5545108 (WAGNER et al)	
A	US 5416698 (HUTCHISON) referred to on page 2.	
A	US 4463842 (REDZINSKI) referred to on page 2.	
A	US 3927579 (GOLAN)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.